What is claimed is:

1. A method of synthesizing a particulate zero strain lithium titanate intercalation compound comprising:

providing a homogeneous precursor mixture comprising nanostructure TiO_2 and at least one thermolabile source of lithium ions;

heating said precursor mixture rapidly to an annealing temperature of about 750-800°C;

holding said mixture at said annealing temperature for a period of time not substantially longer than that required to effect the maximum available reaction of said mixed precursor components in synthesizing said intercalation compound particles; and

cooling said synthesized particles rapidly to a temperature below the reaction temperature required for the synthesis of said intercalation compound, thereby preventing further growth of said particles.

2. A method according to claim 1 wherein said step of heating said precursor mixture comprises heating to said annealing temperature in about 2 minutes in the presence of a heating medium.

3. A method according to claim 2 wherein said heating medium consists essentially of ambient atmosphere.

4. A method according to claim 1 wherein said step of holding said mixture comprises holding at said annealing temperature for about 15-30 minutes in the presence of a heating medium.

5. A method according to claim 4 wherein said heating medium consists essentially of ambient atmosphere.

6. A method according to claim 1 wherein said step of cooling said synthesized particles comprises cooling below said reaction temperature in about 2 minutes in the presence of a cooling medium.

7. A method according to claim 6 wherein said cooling medium consists essentially of ambient atmosphere.

8. A nanostructure particulate zero strain lithium titanate intercalation compound.

9. A particulate lithium titanate intercalation compound synthesized by a method comprising:

providing a homogeneous precursor mixture comprising nanostructure TiO_2 and at least one thermolabile source of lithium ions;

heating said precursor mixture rapidly to a reactive annealing temperature of about 750-800°C;

holding said mixture at said annealing temperature for a period of time not substantially longer than that required to effect the maximum available reaction of said mixed precursor components in synthesizing said intercalation compound particles; and

cooling said synthesized particles rapidly to a temperature below the reaction temperature required for the synthesis of

said intercalation compound, thereby preventing further growth of said particles.

10. A rechargeable electrochemical cell comprising:

a negative electrode member comprising a first electrochemically active material;

a positive electrode member comprising a second electrochemically active material; and

a separator member comprising an electrolyte interposed between said negative and positive electrode members;

wherein at least one of said active materials comprises a nanostructure particulate zero strain lithium titanate intercalation compound.